

CLAIMS

- [1] A plasma etching method of performing plasma etching to an object made of silicon in a treatment chamber, said plasma etching method comprising:
- 5 introducing, into the treatment chamber, etching gas which includes fluorine compound gas and rare gas; and etching the object by energizing the etching gas into plasma state.
- 10 [2] The plasma etching method according to Claim 1, wherein the etching gas further includes one of oxygen (O_2) gas, carbon monoxide (CO) gas, and carbon dioxide (CO_2) gas, and the fluorine compound gas is sulfur hexafluoride (SF_6) gas.
- 15 [3] The plasma etching method according to Claim 2, wherein the rare gas is helium (He) gas.
- [4] The plasma etching method according to Claim 3, wherein a volume of the helium (He) gas introduced into the treatment chamber is equal to or more than 30% of a total flow rate of the etching gas.
- 20 [5] The plasma etching method according to Claim 4, wherein an inside wall of the treatment chamber is made of an insulating material.
- 25 [6] The plasma etching method according to Claim 5, wherein the insulating material is one of quartz, alumina, an aluminum matrix with alumite treatment, yttrium oxide, silicon carbide, and aluminum nitride.
- 30 [7] The plasma etching method according to Claim 2,

wherein the etching gas further includes chlorine (Cl₂) gas.

[8] The plasma etching method according to Claim 7,
wherein a volume of the chlorine (Cl₂) gas introduced into the
5 treatment chamber is equal to or less than 10% of a total flow rate
of the etching gas.

[9] The plasma etching method according to Claim 1,
wherein the fluorine compound gas is one of sulfur
10 hexafluoride (SF₆) gas and nitrogen trifluoride (NF₃) gas,
and in said energizing into plasma state, electricity having a
frequency that is equal to or more than 27 MHz is supplied to the
etching gas.

15 [10] The plasma etching method according to Claim 9,
wherein the rare gas is helium (He) gas, and
a volume of the helium (He) gas introduced into the treatment
chamber is equal to or more than 80% of a total flow rate of the
etching gas.

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[11] The plasma etching method according to Claim 1,
wherein the etching gas further includes polymer forming gas,
and
the fluorine compound is sulfur hexafluoride (SF₆) gas.

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[12] The plasma etching method according to Claim 11,
wherein the polymer forming gas is one of
octafluorocyclobutane (C₄F₈) gas, trifluoromethane (CHF₃) gas,
octafluorocyclopentene (C₅F₈) gas, and hexafluorobutadiene (C₄F₆)
30 gas.

[13] The plasma etching method according to Claim 1,

wherein the fluorine compound gas is sulfur hexafluoride (SF₆) gas,

and in said energizing into plasma state, electricity having a frequency of 500 kHz is supplied to the etching gas.

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[14] The plasma etching method according to Claim 1, comprising etching the object by using etching gas which includes one of oxygen (O₂) gas, carbon monoxide (CO) gas, and carbon dioxide (CO₂) gas, and uses sulfur hexafluoride (SF₆) gas as the fluorine compound gas; and then further etching the object by using etching gas which includes polymer forming gas and uses sulfur hexafluoride (SF₆) gas as the fluorine compound gas.

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[15] The plasma etching method according to Claim 1, wherein the fluorine compound gas is tetrafluoroethane (CF₄) gas.

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[16] The plasma etching method according to Claim 15, wherein the rare gas is Ar gas.

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[17] The plasma etching method according to Claim 16, wherein a volume of the Ar gas introduced into the treatment chamber is 50% to 90% of a total flow rate of the etching gas.

[18] The plasma etching method according to Claim 1, wherein the etching gas is energized into plasma state by an inductively coupled plasma (ICP) method.

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[19] A device which etches a silicon substrate, said device forming a trench in the silicon substrate using the plasma etching method according to Claim 1.

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